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Perhaps, in some particular states of the atmosphere, such a rod might assist in restoring the equilibrium of the fluid among the *strata* differently affected, by its entering at one place in the rod, and escaping at another, while the earth remained neutral.

If you think, that any thing can be collected from these hints to improve the electrical rod, I am willing they should be communicated to the American Academy of Arts and Sciences for their consideration.

I am with much respect, Sir,

Your most obedient servant,

LOAMMI BALDWIN.

Rev. Joseph Willard, D.D. L.L.D.

Vice President of the American Academy of Arts and Sciences.

Woburn, Jan. 25, 1797.



Remarks on the Hon. LOAMMI BALDWIN's proposed improvement in Lightning Rods, in a letter from AARON PUTNAM, Esq. to the Rev. JEDIDIAH MORSE, D.D. A.A.S.

REV. SIR,

AGREEABLY to your request, I now send you the few remarks I made the last summer, upon the communication of the Hon. L. Baldwin, Esq. on electrical rods, published by order of the American Academy of Arts and Sciences, in the
Columbian

Columbian Centinel, 11th August, 1798. Mr. Baldwin has very long and deservedly held a high rank in the scientific part of society ; and no one, I presume, has a higher opinion of him as a man and a philosopher, than myself ; and it is with diffidence I observe, that in my opinion, he has erred in his philanthropic intentions of rendering electrical conductors more beneficial to mankind. As they have been used, they certainly have not afforded complete protection ; but from what cause they have failed, remains to be determined.

From a variety of experiments, which I have made on the subject, I am led to conceive of the matter relating both to the conductors, and the formation or *strata* of the clouds, in a different point of view from Mr. Baldwin.

In the first place, I conceive heat to be the most subtle of all fluids ; and of course the grand *primum mobile* ; that heat has the power of dissolving or liquifying air ; the air of dissolving water (the same as water has of dissolving salt or sugar) in such manner as to render it invisible to human sight ; therefore the greater the quantity of heat operating on the air, the larger the quantity of water that air will dissolve and render invisible. But apply any thing cold in contact with this warm air, thus filled with watery particles, and the air within the sphere of the cold body, will immediately let fall the water. Of this, we have daily proofs in warm weather, when we bring into a room, where the air is in the abovementioned state, a vessel filled with cold water, a cold stone, or any substance

stance colder than the air, we observe them sweat, as the common expression is, which is nothing more than the falling of the water contained in the surrounding air, brought within the sphere of the cold body ; thus the watery particles of the breath, in warm weather, are instantly dissolved on respiration ; but in cold weather, they are visible, and in extreme cold, fall in gross particles on the surrounding objects.

After several days of summer's heat, a large space of air being in this heated state, clearly establishes this hypothesis, and shews us the cause of thunder storms. A column of cold air bursting into the rarified space, deprives the warm air of the power to sustain the water before invisible ; condensation takes place, which terminates in rain. Dry air, I conceive, to be a non conductor, or at least a very bad one, and that air combined with a portion of water, may be rendered a very poor one, by the application of heat sufficient to dissolve that water ; but when the air in a given space, is deprived of heat by a column of cold air coming in contact, and the watery particles condensed, they become a conductor, and of course will receive the electrical fluid. Thus this column of cold air generating moisture, as above stated, passes through a region of heated or dry air, and by it is in a degree insulated ; and at the same time receives the small portion of electrical fluid contained therein. A cloud thus formed has a sphere, and within that sphere, certain strata differently charged at different times, but they appear to me of so short duration, as to preclude the necessity

necessity of providing a remedy for them ; for we witness the lightning constantly passing from one part of the cloud to the other, and thereby producing an equilibrium.

The electrical fluid being thus contained within the sphere of the cloud, there is an emptying or attractive distance, which is larger than the striking distance ; and a conductor brought within that attractive distance of the sphere, would empty the whole cloud. This being the case, it appears to me a great mistake to place rods for conductors, high in the air, above the object we wish to protect, for it is well known that no object will be so soon stricken as the conductor.

Under these circumstances, we must have a strong propensity for emptying clouds, to run our conductor so high in the air as to empty the highest clouds that should pass, and thereby expose them to the striking distance, when nine out of ten would pass us, and not even come within attractive or emptying distance, provided our conductors were placed but a small height above the object we wish to protect. The only reason I conceive, that can be offered in favour of carrying conductors high in the air, is to meet and empty the cloud sooner ; but this appears to me an inaccurate mode of reasoning ; for if ever a conductor fails to afford protection, it is when a cloud highly charged, approaches so rapidly upon the point, that before there is time for it to be emptied, the point is brought within striking distance, and is then unable to carry off the quantity thrown upon it ; therefore, if the point is placed high
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in the air, for the sake of attracting it, certainly it is in the same ratio exposed to be stricken.

From the preceding observations, I conclude, that a point eighteen *inches* above the highest object we wish to protect, would be much more safe than one of eighteen *feet*. As to the multiplicity of points, I believe them rather prejudicial than otherwise. The Hon. Mr. Baldwin observes, "it is a well known fact that electrical fluid enters and passes off by points and angles, more readily than by spherical terminations." I conceive the electrical fluid passing a rod properly prepared, to be the same, in a degree, as water passing a tube. For experiment, fix a tube with three or more branches, and pour water into each of the branches, at the same time, and you will perceive a very considerable obstruction, where they unite in the common stock, or large tube, from the different directions of the branches. This I think will apply to the electrical fluid; and I have been confirmed in the opinion, from repeated experiments, that a conductor with one point properly fixed, would empty an electrical battery more readily than one with three or four.

I have two other objections to the rod proposed by Mr. Baldwin. First, Provided this rod, filled with points, from top to bottom, should be stricken or overcharged, the electrical fluid would pass off by these points in a variety of directions, much more readily, and of consequence, be more liable to attach itself to surrounding objects, than if the rod were either round or square.

Second.

Second. When the electrical fluid passes from the earth upwards. The earth, from its composition, is infinitely more liable to be charged unequally in *strata*, than the air or clouds. When the lightning strikes, as we term it, it is as often from the earth upwards to the cloud, as from the cloud to the earth; although I conceive this to be a case that will very seldom happen to a rod properly fixed, yet such instances may occur; and most certainly the variety of points terminating in so many directions would be more dangerous, as before observed, than a rod with one point only.

I am sensible, some of the ideas I have here expressed, differ from the generally received opinions on the subject. I however think they can be supported. If they afford you any satisfaction, it will much gratify your very sincere friend,

AARON PUTNAM.

Rev. Dr. Jedidiah Morse.

Charlestown, Jan. 12th, 1799.



Remarks on a Natural Phosphorus. By Doctor SOLOMON DROWN.

Providence, Dec. 30th, 1786.

SIR,

AS the following relation of a phenomenon, observed at a place on Hockanum river, near its junction with the Hudson, by Mr. Jeremiah F. Jenkins, a reputable merchant of this town;